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UNITED STATES DEPARTMENT OF AGRICULTURE  
Bureau of Entomology and Plant Quarantine  
Washington, D. C.

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B. E. P. Q. 499.

Sec. 301.48a ADMINISTRATIVE INSTRUCTIONS TO INSPECTORS ON THE  
TREATMENT OF NURSERY PRODUCTS, FRUITS, VEGETABLES, AND  
SOIL, FOR THE JAPANESE BEETLE

Existing methods authorized for the treatment of sand, soil, earth, peat, compost, manure, nursery stock, fruits, and vegetables for the elimination of the Japanese beetle have been revised and consolidated in these instructions. Methods outlined herein are to be employed as a basis of quarantine certification under regulations 5, 6, and 7 (Secs. 301.48-5 to 301.48-7) of Quarantine No. 48, revised (Sec. 301.48). The issuance of these instructions cancels the methods of treatment prescribed in B. E. P. Q. 359 and its four supplements, B. E. P. Q. 473, B. E. P. Q. 475, and B. E. P. Q. 480.

While no guarantee can be given that no injury will be caused to the commodity, the treatments are recommended only for those commodities which experience has shown were not seriously injured. It must be understood by the nurseryman and shipper that no liability shall attach either to the United States Department of Agriculture or to any of its employees in event of injury. The inspector must bring this condition of treatment and the facts in reference to the use of the chemicals to the attention of some responsible person at the nursery or shipping point before the treatments are applied.

Inspectors must familiarize themselves with cautions for each chemical.

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GRADES REQUIRED AND CAUTIONS ON THE USE OF  
AUTHORIZED CHEMICALS

The chemicals authorized for the treatment of soil, nursery stock, fruits, and vegetables, especially carbon disulphide, carbon disulphide emulsion, ethylene oxide, hydrocyanic acid, and methyl bromide, are dangerous and proper care must be exercised in handling them. The facts in reference to these chemicals must be brought to the attention of some responsible person at the nursery or shipping point before the treatments are applied.

(a) Carbon disulphide.--A technical, C. P., or U. S. P. grade is required. It should be stored in tight drums or cans in a cool, dry place.

The vapor of carbon disulphide is inflammable and explosive. At a temperature of 297° F. it may take fire spontaneously and in the presence of certain metals, particularly copper, it may ignite at considerably lower temperatures. It must be kept away from fire, and from hot objects such as electric light bulbs, unprotected brush-type motors, steam pipes, etc. Lighted cigars, cigarettes, or pipes must never be brought near carbon disulphide.

Carbon disulphide is a blood poison, but poisoning by this chemical is rare. Exposure to the vapor may cause giddiness and headache. When these symptoms develop, the individual should get into the open air.

(b) Carbon disulphide emulsion.--The required carbon disulphide emulsion consists of carbon disulphide, meeting the above requirements, mixed with an equal volume of a castor-oil-soap emulsifier which has been prepared according to the directions published in the Journal of Industrial and Engineering Chemistry, Volume 20, pages 849-850, August 1929.

The carbon disulphide and the castor-oil-soap emulsifier should be obtained in separate containers. The emulsion must never be prepared in a large quantity. It should be prepared in the field as it is used. In preparing the stock emulsion, equal volumes of carbon disulphide and the emulsifier are mixed. This stock emulsion, when diluted with the required amount of water, forms the treating solution.

Carbon disulphide emulsion, even after dilution, is inflammable. The precautions given for handling carbon disulphide must be observed.

(c) Ethylene oxide.--A technical, C. P., or U. S. P. grade is required.

The vapor of ethylene oxide is inflammable and explosive. It must be kept away from fire, and from hot objects such as electric light bulbs, unprotected brush-type motors, steam pipes, etc. Lighted cigars, cigarettes, or pipes must never be brought near ethylene oxide.

Ethylene oxide is not highly toxic to man. Continued exposure to the vapor may cause giddiness and headache. When these symptoms develop, the individual should get into the open air.

(d) Hydrocyanic acid.--Commercial liquid hydrocyanic acid, 96 to 98 percent HCN, or this material absorbed on fiber discoids (which are divided into two units, each comprising a series of discoids held together in the form of a chain) in a can containing 6½ ounces of HCN, or calcium cyanide, 88 percent pure, are required. The cylinders and cans of these cyanide products should be stored in a cool, dry place.

Gaseous hydrocyanic acid is inflammable and explosive. All fire and unprotected brush-type motors must be kept from contact with the gas. Lighted cigars, cigarettes, or pipes should never be carried. In addition it is known that liquid hydrocyanic acid undergoes decomposition on long storage in a closed container. It is advisable that only sufficient of these cyanide products be procured for the season's work. The residue left after fumigation with calcium cyanide is dangerous and great care must be exercised in disposing of it.



Hydrocyanic acid is a violent poison. Inhaling hydrocyanic acid gas or absorbing it through the skin is very dangerous and must be avoided. A suitable gas mask and rubber gloves must be worn at all times when handling hydrocyanic acid, or calcium cyanide, and when opening the hatches of fumigated cars for aeration. If it is absorbed by the system, prompt action may prevent serious consequences. The established principles of first aid in HCN poisoning are: (1) Induce continued heavy breathing of fresh air by artificial respiration, using the Shaefer (Prone pressure) method; (2) neutralize the gas poisoning with weak ammonia fumes or aromatic spirits of ammonia; (3) call a physician. Small bottles of ammonium carbonate, as the source of ammonia fumes, should be readily available as an inhalant at all times.

(e) Lead arsenate.--Lead arsenate which satisfies the standard requirements of the chemical for use as an agricultural spray is required. It should contain at least 30 percent arsenic pentoxide, and not more than 0.75 percent water-soluble metallic arsenic. It should be obtained in powdered form to which no stickers have been added. Lead arsenate should be stored in a dry place that is not accessible to animals.

Lead arsenate is poisonous to man and animals. When applying the material the worker should wear gloves to protect his hands, since the poison may be absorbed into the system through cuts and abrasions of the skin. The worker should keep his hands away from his mouth at all times while handling the material and be sure to wash thoroughly before eating. If absorbed by the system, call a physician, give an emetic such as warm water and mustard, and give milk or white of egg.

(f) Methyl bromide.--The commercial grade is required. Containers of methyl bromide should be stored in a cool, well-ventilated place. Avoid leakage by seeing that the valves on the cylinders are tightly closed.

Methyl bromide is a gas at ordinary temperatures. As it has only a very slight odor, toxic concentrations of methyl bromide may be encountered and the persons so exposed may be unaware of the danger. While methyl bromide is not so toxic as hydrocyanic acid, it is dangerous to inhale the gas or to get the liquid in contact with the skin. Rubber gloves should be worn while releasing the liquid methyl bromide either from cylinders or applicators. CAUTION: Rubber gloves absorb methyl bromide which may result in skin injury if they are worn continuously.

(g) Naphthalene.--Flake naphthalene, free from tar, is required. Naphthalene is not explosive and it burns only with difficulty. It is advisable, however, to keep the material in the solid and gaseous form away from fire.

Long exposure to naphthalene may cause giddiness and headache. When these symptoms develop, the individual should get into the open air.

(h) Paradichlorobenzene.--A technical or C. P. grade of small to medium size crystals is required.

Paradichlorobenzene burns only with difficulty. It is advisable, however, to keep the material from fire. Long exposure to the gas may cause giddiness and headache. When these symptoms develop, the individual should get into the open air.

## TREATMENT OF SOIL IN ABSENCE OF PLANTS

### (i) POTTING SOIL

Potting soil must be treated by the use of heat, carbon disulphide, naphthalene, or lead arsenate.

Fumigated or heat-treated soils should be aerated to remove excessive fumigant or heat before using for potting plants. When stored, the soil must be kept and handled in such a manner as to prevent reinfestation. When stored for a long time, without aeration, it is advisable to thoroughly mix the upper and lower layers in the bin. When used as recommended, these treatments do not impair the fertility of the soil.

Lead arsenate treatments are more limited in their application because of the susceptibility of some nursery plants to arsenical poisoning. E-418 of the Bureau of Entomology and Plant Quarantine gives some information on the susceptibility of nursery plants to lead arsenate in the soil.

#### (1) Heat treatment

Condition and type of soil.---Soil of any type may be treated, provided it is friable.

Temperature.---The soil must be heated throughout to 130° F.

Period of treatment.---The temperature of the soil must be maintained at 130° F. for 30 minutes.

#### (2) Carbon disulphide fumigation

Equipment.---A gas-tight bin or box is required. It is necessary to have the top, sides, and bottom tight.

Condition and type of soil.---Soil of any type may be fumigated, provided it is friable and thrown loosely into the bin or box. Wet soil must never be fumigated.

Temperature.---The temperature must be at least 45° F. when the fumigant is applied and must not fall below 40° F. during the course of the treatment.

Dosage.---One pound (352 cubic centimeters) to 1 cubic yard.

Application.---One method is to apply the fumigant while the soil is being put into the bin or box. Place 18 inches of soil in the bin or box. Inject carbon disulphide at the rate of 176 cubic centimeters for each square yard of surface, distributing the material uniformly in holes 2 inches deep and 18 inches apart, using 44 cubic centimeters to each hole. Fill the holes with soil immediately after the liquid is injected. When the first 18 inches of soil have been treated, put in 18 inches more and repeat the operation. This can be repeated until the container is filled.



Another method is to apply the fumigant after the box or bin has been filled. This is done by making holes from the surface to the different levels, so that the carbon disulphide is applied in the same positions as by the first method. The liquid, in this case, must be poured into the deep holes through a tube, or injected to insure that it reaches the proper level.

Period of fumigation.---The box or bin must be sealed and left undisturbed for 48 hours.

### (3) Naphthalene fumigation

Equipment.---No special equipment is necessary. It is not necessary to cover the soil.

Condition and type of soil.---Soil of any type may be fumigated, provided it is friable. Wet soil must never be fumigated.

Temperature.---The temperature must be at least 50° F.

Dosage.---Five pounds to 1 cubic yard.

Application.---The fumigant must be thoroughly mixed with the soil, and the soil then placed in a pile.

Period of fumigation.---The soil must be left undisturbed for 1 week.

### (4) Lead arsenate treatment

Season.---The treatment must be applied before August 1.

Condition and type of soil.---The soil must be friable. Wet soil must never be treated. The treatment is recommended only for soils which are slightly acid or neutral in reaction. Any type of soil may be treated provided it meets these requirements.

Dosage.---Two pounds to 1 cubic yard.

Application.---The lead arsenate must be thoroughly mixed with the soil.

Period of treatment.---Plants freed from soil and potted in soil treated in the above manner by August 1, may be certified for shipment between the following October 1 and June 15.

Handling of potted plants.---When plants potted in lead-arsenate-treated soil are plunged in beds or set in frames exposed to possible infestation, the soil of these beds or frames must previously have been treated with lead arsenate at the rate of 1,500 pounds per acre.

Treated plants carried after June 15.---When plants potted in soil treated as prescribed are carried after June 15, they may be again eligible for certification between October 1 and June 15 of the second year if, on August 1 of the second year, analyses show the soil to contain lead arsenate at the rate of 2 pounds per cubic yard.

(j) SHIPMENTS OF SAND, SOIL, EARTH, PEAT, COMPOST, AND MANURE

Shipments of sand, soil, earth, peat, compost, and manure must be treated by the use of heat or carbon disulphide. The instructions given in (i) (1) and (i) (2) must be followed.

Type of car.--Tight box cars must be used between June 15 and October 15, inclusive, and may be used at other times of the year. Open freight cars, of the steel gondola type, may be used between October 16 and June 14. In cars of this type, with dump bottoms, planks must be laid on the bottoms and covered with heavy paper, in a manner approved by the inspector.

Doors.--The doorways of box cars must be boarded up and covered with heavy paper up to a point beyond the height of the sand, soil, etc. Certified cars must have the doors closed and fastened while en route within the regulated area.

Depth of sand, soil, etc.--In box cars, the sand, soil, etc. must not be loaded to such a depth as would restrict the overhead working space and hamper the work of the men applying the treatment. In the open type cars, the material should not be piled above the sides of the car.

Covering with canvas, etc.--When open type cars are used, canvases or heavy paper must be used to cover the surface as the treatment is applied. These covers must be free from holes and a foot or more wider than the width of the car. Where several pieces are used, they must be large enough to allow for overlapping at least 1 foot. The covers must be fastened down at the sides of the car and weighted on the surface, particularly where they overlap.

(k) SOIL IN AND AROUND COLDFRAMES, PLUNGING BEDS, AND HEELING-IN AREAS

Soil in and surrounding coldframes, plunging beds, heeling-in areas, etc., must be treated with lead arsenate, except, under special conditions, when the inspector may authorize the use of heat, carbon disulphide, carbon disulphide emulsion, or naphthalene. With the exception of lead arsenate, the treatment must not be applied when adult beetles are present. An exception may be made in the case of beds protected from beetles.

Safety zone.--In addition to the area desired to be certified, a strip 3 feet wide must be treated around the entire coldframe, plunging bed, or heeling-in ground. No plants will be certified from this strip. In the case of coldframes, etc., extending into the ground to a depth of 12 inches or more, no safety zone is required.

Marking.--In the case of coldframes, etc., having fixed boundaries, proper designations will be made on them by the Department representatives. In all other cases, the nurseryman shall furnish suitable stakes, at least 4 inches square and 30 inches long, to be placed at the boundaries of the certified plots and marked by the Department.

### (1) Lead arsenate treatment

Season.--The treatment must be applied before August 1 if the land is to be used in the fall.

Condition of soil.--The soil must be friable and in good tilth.

Dosage.--Thirty-five pounds to each 1,000 square feet, or 1,500 pounds per acre. For subsequent re-treatments, the quantity required to restore the original concentration, as determined by chemical analyses, must be applied.

Application.--The lead arsenate must be thoroughly mixed and incorporated with the upper 3 inches of soil.

Period of treatment.--Plants must not be placed on or in the soil thus treated until after October 1.

### (2) Heat treatment

Hotbeds, equipped with steam pipes or electrical resistance coils in the soil, may be treated by heating the soil to at least 130° F. and maintaining this temperature from 30 minutes.

### (3) Carbon disulphide fumigation

Equipment.--A heavy paper, or other gas-proof cover, must be provided to cover the soil during the fumigation period.

Condition of soil.--The soil must be friable and in good tilth. A wet soil must never be treated.

Temperature.--The temperature of the soil at a depth of 6 inches must be at least 45° F. when the fumigant is applied, and must not fall below 40° during the period of treatment.

Weather conditions.--The ideal conditions are a warm, humid atmosphere without wind.

Dosage.--Six pounds (2,100 cubic centimeters) to 100 square feet of surface.

Application.--Carbon disulphide must be uniformly distributed over the surface of the bed, plot, or heeling-in area. Apply it in holes 12 inches apart and 1 to 2 inches deep, putting 21 cubic centimeters into each hole. Fill each hole with soil immediately after the liquid is poured. Cover each section as soon as the fumigant is applied.

Period of treatment.--The soil must remain covered for 48 hours.



#### (4) Carbon disulphide emulsion treatment

Equipment.---Suitable tanks, barrels, or tubs for preparing the emulsion and 24-gage galvanized-iron collars 10 inches wide and not more than 4 feet square, for applying the treatment, must be provided.

Condition of soil.---The soil must be friable. The surface must be level and not disturbed by recent cultivation. Drainage conditions must be such that the solution does not disappear from the surface in less than 10 minutes or more than 5 hours.

Temperature.---The temperature of the soil at a depth of 6 inches must be at least 45° F. when the treatment is applied, and must not fall below 40° during the period of the treatment.

Dosage.---Two and one-half gallons of dilute emulsion to each square foot. The concentration is dependent upon the temperature. Follow table 3 of paragraph (m) (1).

Application.---Level the surface of the soil, removing weeds and debris. Force a galvanized-iron collar 3 inches into the ground, and firm the soil against the metal. Place another collar next to the first, and so on. When enough collars are in place, pour the dilute emulsion into the basins formed within the collars. As soon as the liquid has disappeared from the surface, the collar may be lifted and set in another position.

Period of treatment.---The soil must not be disturbed for 48 hours.

#### (5) Naphthalene fumigation

Condition of soil.---The soil must be friable and in good tilth.

Temperature.---The temperature of the soil at a depth of 6 inches must not be less than 50° F. during the period of the treatment.

Dosage.---Forty-six pounds to 1,000 square feet, or 2,000 pounds per acre.

Application.---The naphthalene must be thoroughly mixed and incorporated with the upper 3 inches of soil.

Period of treatment.---The soil must not be disturbed for 1 week.

#### TREATMENT OF SOIL ABOUT THE ROOTS OF PLANTS

The effect of insecticidal treatments on plants, when applied to soil about their roots, varies with the variety, age, vigor, and condition of the plants. It should be understood that these treatments have not been tried on all varieties of plants, or under all of the varied conditions in the nurseries. In general, it is not possible to destroy an insect in close proximity to the roots without causing some damage to the plant. While guarantees can not be given that no injury will be caused to the plants, the treatments are recommended only for those plants which experience has shown were not seriously injured.

It must be understood by the nurseryman that no liability shall attach either to the United States Department of Agriculture or to any of its employees in event of injury.

After all treatments, the plants must be handled in such a manner as to prevent reinfestation.

### (1) TREATMENT OF PLANTS AFTER DIGGING

#### (1) Removal of infestation

With some deciduous and herbaceous plants, infestation can be removed by shaking and washing all soil from the roots. Only such root masses as can be thoroughly examined and absence of infestation verified may be certified by this procedure.

#### (2) Hot-water treatment

Equipment.---A water tank, equipped with a suitable heating device and circulating system, must be provided.

Temperature.---The water must be maintained at 112° F., with a variation of not more than  $\pm 0.5^\circ$ . Before the plants are immersed, thermometers must be inserted in the center of at least three of the largest clumps, baskets, or root masses placed at each end and at the center of the tank. In addition, three thermometers must be placed in the water of the tank in the same relative positions as those in the root masses. Temperature readings from each of these thermometers must be recorded on Form No. 91.

Application.---The root masses must be immersed completely.

Period of treatment.---Seventy minutes after the root masses are heated to 112° F.

Varieties of plants.---The varieties which have been treated successfully by this procedure are given in Technical Bulletin 274.

Preparation of plants.---Large clumps should be divided as much as possible without injuring the roots. Excess soil should be removed and the roots pruned. Small plants and root stocks may be packed loosely in wire baskets or in other suitable containers, provided the water can circulate through the masses. Large plants must be placed individually in the water.

Care of plants after treatment.---Plants should be cooled slowly to room temperature. Pot or heel them in the ground as soon as possible after cooling. Tubers should be dry when packed. Avoid subjecting treated plants to freezing temperatures shortly after treatment.

#### (3) Carbon disulphide emulsion dip

Equipment.---Water-tight tanks or tubs must be provided.



Temperature.---The temperature of the dip must be maintained between 65° and 70° F.

Dosage.---Forty-five cubic centimeters of carbon disulphide emulsion to 10 gallons of water. The treating solution must be prepared immediately before using.

Application.---The root masses must be immersed completely.

Period of treatment.---The root masses must be immersed 24 hours.

Varieties of plants.---The varieties which have been treated successfully by this procedure are given in Technical Bulletin 478.

Preparation of plants.---Large clumps should be divided as much as possible without injuring the roots. Excess soil should be removed. No wet root masses or root masses measuring more than 6 inches across the narrowest dimension must be treated. The temperature of the root masses must be at least 60° F. before treatment. Small plants and root stocks may be packed loosely in wire baskets or other suitable containers, provided the dipping solution can circulate through the masses. Larger root masses must be placed individually in the dip.

Care of plants after treatment.---Tubers should be dry when packed. Avoid subjecting treated plants to freezing temperatures shortly after treatment. It is advisable to allow plants which are to be potted to stand in the open to permit evaporation of the fumigant before placing them in soil.

#### (4) Paradichlorobenzene fumigation

Season.---The treatment must be applied between October 1 and May 1.

Varieties of plants.---The following varieties of plants have been treated successfully by this procedure: Aquilegia sp. var. Mrs. Scott Elliott's hybrid, Anemone hupehensis, Artemisia dracunculus, Azalea amoena, A. kienpferi vars. Cleopatra, Fedora, Othello, and Salmon Beauty, A. hinodegiri, A. obtusa kiusiana var. Coral Bells, Aster alpinus, Campanula medium, Ceratostigma plumbaginoides, Chrysanthemum sp., Dianthus caryophyllus var. Abbotsford Pink, Digitalis purpurea, Eupatorium coelestinum, Helianthemum glaucum croceum, Iberis amara, Myosotis sp., Pachysandra terminalis, Phlox sp. var. R. P. Struthers, Santolina chamaecyparissus incana, Sedum acre, Sempervivum alberti, Stokesia laevis, Thymus serpyllum, Viola sp. vars. Jersey Gem and Rosina.

Preparation of plants.---Excess soil should be removed and the mass reduced as much as possible without injuring the roots. The plant ball should be moist, but not wet. Pots must be removed from potted plants. When burlap on balled plant is of coarse weave, it may be left on the balls, but when it is closely woven, it must be removed.

Preparation of plunging soil.---The paradichlorobenzene must be thoroughly mixed with a light sandy loam, or sand, which is moist but not wet, and free from lumps, stones, and debris. It must be mixed immediately before using.

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Care of plants during treatment.--If it is necessary to water the plants during the treatment to prevent desiccation, the operation must be limited to a light syringing, under the supervision of an inspector.

Care of plants after treatment.--It is advisable to avoid excessive watering of the plants after treatment in order to permit any residual gas to escape from the plant balls.

#### (i) Complete coverage

Temperature.--The temperature of both the treating soil and the soil ball must not be less than 50° F. during the period of treatment. To prevent injury to the plants, it should not go above 65°.

Dosage.--Ten pounds per cubic yard of mixing soil (6 oz. per cu. ft.) for soil balls up to 6" in diameter at the narrowest dimension. Twenty pounds per cubic yard of mixing soil (12 oz. per cu. ft.) for soil balls from 6" to 8" in diameter at the narrowest dimension.

Application.--Spread a layer of the treated plunging soil on a smooth hard surface, such as a floor or bench, and then place a row of plants, with the balls spaced at least 1 inch apart, on this soil. Fill the spaces between the plant balls with treated soil and cover the plant balls to a depth of 1 inch. Then, place about 1 inch of treated soil against the row of plants. This operation is repeated until all the plants are plunged.

Period of treatment.--The plants must be left undisturbed for a period of 5 days.

#### (ii) Side application

Temperature, dosage, period of treatment.--The various combinations of dosage and exposure which may be used at different temperatures are given in table 1. It is desirable to maintain the temperature fairly constant. The temperatures given at the head of the column in table 1 are the minimum temperatures during the period of treatment.



Table 1.--Temperature, dosage, and period of treatment for paradichlorobenzene

Width or depth of plant ball	Crystals per cubic yard of plunging soil	Period of treatment required when the minimum temperature in °F. is within the range indicated below						
		45-49	50-54	55-59	60-64	65-69	70-74	
	Pounds	Days	Days	Days	Days	Days	Days	Days
Up to 2 inches--	1	*	--	10	9	7	5	
	5	9	7	6	5	4	2	
	10	7	6	5	4	3	2	
	20	5	5	4	3	2	1	
2-4 inches----	1	--	--	--	--	10	6	
	5	--	10	10	9	8	4	
	10	9	8	8	7	6	3	
	20	7	7	6	6	5	2	
4-6 inches----	1	--	--	--	--	--	--	
	5	--	--	--	--	--	--	
	10	--	--	--	--	9	7	
	20	--	--	8	7	6	4	

\*Blank spaces indicate that the exposure period is more than 10 days.

Application.---Spread a layer of the treated plunging soil on a smooth hard surface, such as a floor or bench, and then place a row of plants, with the balls spaced at least 1 inch apart, on this soil. Fill the spaces between the plant balls with treated soil, taking care not to get the treated soil in contact with the stems of the plants, and cover the upper side of the plant balls with treated soil to within 2 inches of the stems. Then, place about 1 inch of treated soil against the row of plants. The operation is repeated until all the plants are plunged.

#### (5) Methyl bromide fumigation

Equipment.---A fumigation chamber, of approved design, equipped with vaporizing, air-circulating, and ventilating systems must be provided.

Application.---After the chamber is loaded, the methyl bromide must be vaporized within it. The air within the chamber must be kept in circulation during the period of fumigation. At the completion of the treatment, the chamber must be well ventilated before it is entered and the plants removed. The ventilating system should also be in continuous operation during the entire period of removal of the fumigated articles.

#### (i) Fumigation of plants, with or without soil

Temperature.---The temperature of the soil (with bare root stock, the root spaces) and air must be at least 63° F. during the entire fumigation period.

Dosage.---Two and one-half pounds of methyl bromide per 1,000 cubic feet, including the space occupied by the load.

Period of treatment.---Two and one-half hours.

Preparation of plants.---The treatment is to be applied only to plants with bare roots or in 8-inch pots, or smaller, or in soil balls not larger than 8 inches in diameter or thicker than 8 inches when not spherical. The soil should not be puddled or saturated. With wet material drying for a period of 12 hours is advisable before treatment. The plants should be stacked on racks or separated so that the gas can have access to both top and bottom surfaces of pots or soil balls. While not essential that the balls be completely separated from each other, they should not be jammed tightly together.

Varieties of plants.---The list of plants, including greenhouse, perennial, and nursery stock types treated experimentally is subject to continual expansion and, moreover, is too great to include in these instructions. Such a list, including also those which have been injured by the treatment, will be supplied on request.

(ii) Fumigation of strawberry plants in shipping crates of field-packed baskets

Temperature.---The temperature of the plants and air must be at least 60° F. during the entire fumigation period.

Dosage.---Three pounds of methyl bromide per 1,000 cubic feet, including the space occupied by the load.

Period of treatment.---Four hours.

Preparation of plants.---Strawberry plants may be fumigated either bundled and packed in damp moss in slatted shipping crates or in field-packed baskets of 1 bushel, or less. The load in the fumigation space should be arranged to allow the gas to enter from all sides of the containers.

Varieties of plants.---This treatment has been authorized for strawberry plants only.

## (m) TREATMENT OF PLANTS BEFORE DIGGING

### (1) Carbon disulphide emulsion

Equipment.---Strips or squares of 24-gage galvanized iron, 10 inches wide of the proper size, and water-tight cans or tubs must be provided.

Season.---This treatment must not be used when adult beetles are present.

Temperature.---The treatment must not be applied when the temperature of the soil at a depth of 6 inches is below 40° F., or it is anticipated that the temperature will fall below this during the period of treatment.



Dosage.---The dosage of stock emulsion which must be used is dependent upon the minimum soil temperature anticipated during the period of the treatment. Schedules 1, 2, and 3 in tables 2 and 3 give the dosages required for the treatment of plant balls of various sizes.

Period of treatment.---The soil must not be disturbed for 48 hours.

Period of digging.---The plants must be dug within 3 days after the completion of the treatment.

Varieties of plants.---The varieties which have been treated successfully by this method are given in Technical Bulletin 478.

Preparation of plants.---The surface of the soil about the base of the plant must be practically level; treatment must not be applied on a slope which cannot be levelled without filling. Weeds and debris must be removed from the surface of the soil. It is advisable to tie low-hanging branches so they will not dip into the treating solution. After the size of the ball to be lifted with the plant has been determined, a galvanized-iron collar of the proper size is placed about the base of the plant and forced to a depth of 3 inches into the soil. The soil must be firmed carefully on each side of the galvanized iron to prevent seepage.

Application.---The quantity of treating solution to be used must be determined from tables 2 and 3. The required quantity of stock emulsion is added to water and mixed well. Then the solution is poured into the collar, avoiding splashing or unnecessary disturbance of the soil. Pouring the solution on a spade will be of considerable help. A record must be made of the time required for the treating solution to disappear from the surface. Drainage conditions must be such that the solution does not disappear from the surface in less than 10 minutes or more than 5 hours. An examination must be made after the treatment has been applied to determine the uniformity of penetration.

Handling plants after treatment.---The inspector must be sure that a ball of soil no larger than that originally planned is removed with the plant.

## (2) Lead arsenate treatment

Season.---Treatment must be applied by July 1. Plants may be certified when the period of treatment is completed, and until the following June 15.

Condition of soil.---The soil must be friable and in good tilth. This treatment is recommended only for soils that are slightly acid or neutral in reaction.

Dosage.---Thirty-five pounds to each 1,000 square feet, or 1,500 pounds per acre. For subsequent re-treatments, the quantity required to restore the original concentration, as determined by chemical analyses, must be applied.

Period of treatment.---Plants in plots treated initially must not be dug until October 1; those on re-treated plots may be dug on September 20.

Application.--Lead arsenate must be thoroughly mixed and incorporated with the upper 3 inches of soil. The ridge of soil between the plants in the rows and the soil about the base of the plants must be removed to a depth of 2 inches and placed in the space between the rows of plants. Lead arsenate may be applied with a suitable distributor, or broadcast by hand, before or after the hoeing operation is completed. Then the soil between the rows of plants must be cultivated three times. On the last cultivation, the cultivator is adjusted in such a manner that the treated soil is thrown toward the rows of plants. At least 3 inches of treated soil must be placed in the rows about the bases of the plants.

Varieties of plants.--The varieties of plants which have been treated successfully by this method are given in Bureau of Entomology and Plant Quarantine E-418.

Safety zone.--Same as that prescribed in (k).

Marking.--Same as that prescribed in (k).

Table 2.--Dosage for circular collars

Diameter of ball: to be dug	Diameter: of collar	Water	Stock carbon disulphide emulsion		
			Schedule No. 1: 40-50° F.	Schedule No. 2: 50-60° F.	Schedule No. 3 60-70° F.
	Inches	Gallons	cc.	cc.	cc.
12 inches or less--	18	4.5	31	26	20
14 inches-----	21	6.0	41	34	27
18 inches-----	27	10.0	68	57	45
20 inches-----	30	12.0	82	68	54
22 inches-----	33	15.0	102	85	68
24 inches-----	36	17.5	119	99	80
25-27 inches-----	39	21.0	143	119	95
28-30 inches-----	42	24.0	164	136	108
33 inches-----	45	27.5	187	156	125
36 inches-----	48	31.5	215	179	143



Table 3.--Dosage for square collars

Diameter of ball to be dug	:Length :		:		Stock carbon disulphide emulsion		
	:of side:		:				
	: of	: Water	: Schedule No. 1:	: Schedule No. 2:	: Schedule No. 3		
	: collar :	:	: 40-50° F. :	: 50-60° F. :	: 60-70° F.		
	:Inches :	:Gallons:	cc. :	cc. :	cc.		
12 inches or less:	18	: 5.5 :	37	: 31 :	25		
14 inches-----:	21	: 7.5 :	51	: 43 :	34		
18 inches-----:	27	: 12.5 :	85	: 71 :	57		
20 inches-----:	30	: 15.5 :	106	: 88 :	70		
22 inches-----:	33	: 19.0 :	129	: 108 :	86		
24 inches-----:	36	: 22.5 :	153	: 128 :	102		
25-27 inches-----:	39	: 26.0 :	177	: 148 :	118		
28-30 inches-----:	42	: 30.5 :	208	: 173 :	139		
33 inches-----:	45	: 35.0 :	238	: 199 :	159		
36 inches-----:	48	: 40.0 :	272	: 227 :	182		
	:	:	:	:	:		

#### TREATMENT OF FRUITS AND VEGETABLES

The effect of insecticidal treatments on fruits and vegetables varies with the variety and the condition. While guarantees cannot be given that no injury will be caused to the fruits and vegetables, the treatments are recommended only for those commodities which experience has shown were not seriously injured. It must be understood by the shipper that no liability shall attach either to the United States Department of Agriculture or to any of its employees in event of injury to the commodities.

After all treatments, the commodities must be handled in such a manner as to prevent reinfestation by the adult Japanese beetles.

#### (n) CARBON DISULPHIDE FUMIGATION

Equipment.---A fumigation chamber, of approved design, equipped with a vaporizing, air-circulating, and ventilating system must be provided.

Temperature.---The temperature must be at least 30° F. during the treatment.

Dosage.---Ten pounds to each 1,000 cubic feet in the chamber.

Period of treatment.---Two hours.

Varieties of fruit.---The varieties of fruit treated successfully by this method are given in Circular 373.

Preparation of fruit.---The crates and baskets of fruit must be stacked in the chamber in such a manner that the gas will have access to all sides of the containers.

Application.---After the chamber is loaded, the carbon disulphide must be vaporized within it. The water in the coils of the vaporizing pan must be at least 148° F. and should never exceed 180°. The water must be circulated through the coils of the vaporizing pan for 60 minutes after the fumigant has been put into the pan. The air within the chamber must be kept in circulation during the period of fumigation. At the completion of the treatment, the chamber must be well ventilated before it is entered and the fruit removed.

### (c) CYANIDE FUMIGATION

Equipment.---Refrigerator cars in good condition and dry must be provided. Four screens, made of cotton netting on light wooden frames which fit tightly over the hatch openings, and equipped with three wires for fastening to the hatch cover, hinges, and graduating arm, must be provided for each car.

When liquid hydrocyanic acid is used, two metal trays having an area of 2 square feet and equipped to be suspended about 24 inches below the hatch cover, a 3-ounce measuring cup, and a tube for putting the material into the pans must be provided.

When HCN discoids are used, an approved type of can opener must be provided.

When calcium cyanide is used, two trays of light wooden construction, 6 to 8 feet long, 2 feet wide, and 2 inches deep, and sufficient building paper to properly cover these trays must be provided.

Temperature.---The temperature must be at least 75° F. in the car during the treatment.

<u>Dosage.</u> ---	Liquid hydrocyanic acid . . . . .	6	ounces per car.
	HCN discoids . . . . .	6.5	ounces per car
	Calcium cyanide, 88 percent . . . . .	3	pounds per car

<u>Period of treatment.</u> ---	Liquid hydrocyanic acid)	2 hours
	HCN discoids . . . . .)	
	Calcium cyanide . . . . .	1.5 hours

Varieties of fruits and vegetables.---This treatment is authorized for bananas and empty refrigerator cars.

Preparation of commodities.---The bananas must be stacked in such a manner that the gas will have access to all sides.

Application, liquid hydrocyanic acid.---The doors must be closed tightly and the ice drips properly plugged. Remove one insulating plug from each bunker and suspend a tray therein. Fill the 3-ounce measuring device with liquid hydrocyanic acid, and pour through the tube into the pan. Replace the plug and close the hatch cover tightly. Then repeat the operation in the ice bunker at the opposite end of the car.

HCN discoids.---The doors must be closed tightly and the ice drips properly plugged. Remove one insulating plug from each ice bunker. Open the can, remove one discoid unit and suspend it immediately in the bunker, holding the string at



the edge of the opening and wedge it in position by closing and fastening the insulating plug. The open end of the can must be covered with the fiber cap immediately after the unit is removed to prevent loss of gas. Then, place the second dis-coid unit in the bunker at the opposite end of the car.

Calcium cyanide.---The doors and the hatches must be tightly closed and the ice drips properly plugged. Open one door. Cover the trays with paper and apply  $1\frac{1}{2}$  pounds of calcium cyanide uniformly to the paper in each tray. Then place the trays on the load near the door of the car. Finally, close the door tightly.

After the treatment is completed, open the hatches and place the screens in position and remove the plugs from the ice drips. Remove the pans and trays. Doors must be kept closed, unless an approved screen has been provided.

#### (p) ETHYLENE OXIDE FUMIGATION

Equipment.---A fumigation chamber, of approved design, equipped with vaporizing, air-circulating, and ventilating systems must be provided.

Temperature.---The temperature must be at least 75° F. during the treatment.

Dosage.---Two pounds for each 1,000 cubic feet in the chamber.

Period of treatment.---Two hours.

Varieties of fruit.---The varieties of fruit treated successfully by this method are given in Circular 373.

Preparation of fruit.---The crates and baskets of fruit must be stacked in the chamber in such a manner that the gas will have access to all sides of the containers.

Application.---After the chamber is loaded, the ethylene oxide must be vaporized in the pan in the chamber. The air within the chamber must be kept in circulation during the period of fumigation. At the completion of the treatment, the chamber must be well ventilated before it is entered and the fruits removed.

#### (q) METHYL BROMIDE FUMIGATION

##### (1) Refrigerator cars

Equipment.---Refrigerator cars must be in fair condition with sound, well-fitting doors and hatches. Standard cloth screens for covering the hatches and a temporary cloth screen for covering one door during ventilation are essential. An electric blower of not less than 750 CFM capacity against  $\frac{1}{4}$ -inch water pressure, equipped with devices for lowering into the bunker and securing, so that the blower outlet butts against the bunker screen unimpeded either by studs or burglar bar.

Temperature.---The temperature within the car must be at least 70° F. during the treatment.

Dosage.---Two pounds for each 1,000 cubic feet; or 5 pounds per refrigerator car.



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Period of treatment.--Two hours from the end of the fumigant release period.

Application.--The doors must be closed tightly and the ice drips properly plugged. The methyl bromide may be released either by weight or measure, through a copper or brass applicator tube of  $\frac{1}{4}$ -inch bore. This tube must be fitted with a disc-type spray nozzle and must be bent in a "U" shape at the end, so that the spray nozzle is directed upward toward the center of the bunker and not less than 1 foot below the ceiling during the release of the fumigant. The blower must be in continuous operation during the release of the fumigant and for 5 minutes thereafter. At the end of this period the blower may be removed and transferred to the next car. The fumigant must be released in a split dosage consisting of 3 pounds in the bunker end through the hatch across from the blower and 2 pounds in the hatch at the opposite end of the car and in line with the blower.

Ventilation.--At the end of the exposure period, all hatches must be immediately propped open and screened, and the drip plugs removed. One door must be opened and screened for a period of 20 minutes, following which it should be closed and sealed. If the car is to be moved within one-half hour, the opening of the door may be omitted.

Commodities treated.--The treatment is approved for the following fruits and vegetables: White potatoes, sweetpotatoes, onions, tomatoes, snap beans, Lima beans, sweet corn, cabbage, carrots, beets, apples, and peaches.

(2) Fumigation house, room, and box

The commodities listed above may be fumigated in approved fumigation chambers. The same requirements as to dosage, circulation period, exposure, temperature, and screening of doors listed under refrigerator car fumigation apply. The chamber must be ventilated with the ventilating equipment in continuous operation for one-half hour. All ventilator intakes must be protected with 8-mesh wire screen. The ventilating fan must run during both the placing and removal of the load. In addition, the requirements for screened loading facilities and the subsequent certification of loads must be met. (Issued under Sec. 301.46)  
[B. E. P. Q. 499, June 9, 1939]

S. A. ROHWER.

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